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Sac County, Iowa

Pacific Northwest Environmental Research Lab, Corvallis, Oreg

Prepared for

Iowa Dept of Environmental Quality, Des Moines

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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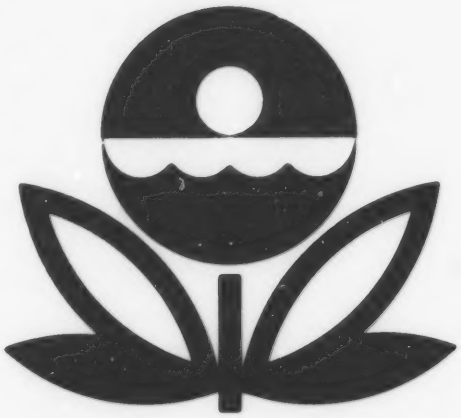

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REPORT

ON

BLACK HAWK LAKE

SAC COUNTY

IOWA

EPA REGION VII

WORKING PAPER No. 496

WITH THE COOPERATION OF THE

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND THE

IOWA NATIONAL GUARD

AUGUST, 1976

CONTENTS

	Page
Foreword	ii
List of Iowa Study Lakes	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	3
III. Lake Water Quality Summary	4
IV. Nutrient Loadings	8
V. Literature Reviewed	12
VI. Appendices	13

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Iowa Department of Environmental Quality for professional involvement, to the Iowa National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Water Quality Division of the Department of Environmental Quality provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General Joseph G. May, the Adjutant General of Iowa, and Project Officer Colonel Cleadeth P. Woods, who directed the volunteer efforts of the Iowa National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IOWA

LAKE NAME	COUNTY
Ahquabi	Warren
Big Creek Reservoir	Polk
Black Hawk	Sac
Clear	Cerro Gordo
Darling	Washington
Lost Island	Clay, Palo Alto
MacBride	Johnson
Prairie Rose	Shelby
Rathbun Reservoir	Appanoose, Wayne
Red Rock Reservoir	Marion
Rock Creek	Jasper
Silver	Worth
Spirit	Dickinson
Viking	Montgomery
West Okoboji	Dickinson

Indian
River
Lakeview
BLACK HAWK LAKE
X01
X02
A1
outlet
B1
Iowa
Map Location
42°15'
42°10'
95°05'
95°00'
BLACK HAWK LAKE
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 1 2 3 4 5 Km.
0 1 Scale 2 3 Mi.

BLACK HAWK LAKE

STORET NO. 1903

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Black Hawk Lake is eutrophic. This lake ranked fourteenth in overall trophic quality when the 15 Iowa lakes and reservoirs sampled in 1974 were compared using a combination of six parameters*. Thirteen of the water bodies had less median total phosphorus, 11 had less median dissolved phosphorus, four had less and one had the same median inorganic nitrogen, 13 had less mean chlorophyll a, and all of the other water bodies had greater Secchi disc transparency.

Survey limnologists did not observe surface concentrations of algae, but the numbers of phytoplankton in July and September indicate blooms at those times (see page 6).

B. Rate-Limiting Nutrient:

The algal assay results indicate that Black Hawk Lake was phosphorus limited at the time the assay sample was collected (04/19/74). The lake data indicate phosphorus limitation in April but nitrogen limitation in September.

C. Nutrient Controllability:

1. Point sources--During the sampling year, the phos-

* See Appendix A.

phorus contributions of domestic point sources amounted to 1.2% of the total phosphorus load. All of this load is attributed to lakeshore septic tanks, but a shoreline survey would be necessary to determine the actual significance of those sources.

The present loading of 0.55 g/m^2/year is well over that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11). Because this lake is phosphorus limited at least part of the time, the incoming phosphorus load should be reduced to the greatest practicable extent.

2. Non-point sources--The phosphorus contribution of non-point sources accounted for 98.8% of the total phosphorus load during the sampling year. The Unnamed Stream B-1 contributed 79.6%, and ungaged tributaries were estimated to have contributed 16.0% of the load.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 3.72 kilometers^2.
2. Mean depth: 1.7 meters.
3. Maximum depth: 3.7 meters.
4. Volume: 6.324×10^6 m^3.
5. Mean hydraulic retention time: 271 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Unnamed Stream B-1	47.1	0.21
Minor tributaries & immediate drainage -	9.5	0.06
Totals	56.6	0.27

2. Outlet -

Unnamed Stream A-1	60.3**	0.27

C. Precipitation***:

1. Year of sampling: 83.7 centimeters.
2. Mean annual: 72.6 centimeters.

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† Table of metric conversions--Appendix B.
†† Harrison, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Black Hawk Lake was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at two stations on the lake (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll *a* analysis. The maximum depth sampled at each of the stations was 0.6 meters.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not preserved properly and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR BLACK HAWK LAKE
STORET CODE 1903

PARAMETER	1ST SAMPLING (4/19/74) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 3/74) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/25/74) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	12.4 - 12.7	12.5	12.5	24.5 - 25.2	24.9	24.9	14.6 - 15.2	14.9	14.9
DISS OXY (MG/L)	------			- 8.8			8.6 - 9.0	8.8	8.8
CNDCTVY (MCROMO)	186. - 187.	187.	187.	456. - 467.	462.	462.	321. - 323.	322.	322.
PH (STAND UNITS)	8.6 - 8.6	8.6	8.6	8.9 - 8.9	8.9	8.9	8.1 - 8.2	8.2	8.2
TOT ALK (MG/L)	168. - 177.	173.	173.	------			145. - 148.	146.	145.
TOT P (MG/L)	0.161 - 0.168	0.164	0.164	------			0.181 - 0.198	0.191	0.193
ORTHO P (MG/L)	0.012 - 0.013	0.012	0.012	------			0.019 - 0.024	0.022	0.022
NO2+NO3 (MG/L)	2.150 - 2.390	2.270	2.270	------			0.040 - 0.070	0.055	0.055
AMMONIA (MG/L)	0.040 - 0.060	0.050	0.050	------			0.060 - 0.070	0.067	0.070
KJEL N (MG/L)	1.400 - 1.800	1.600	1.600	------			1.600 - 1.700	1.625	1.600
INORG N (MG/L)	2.190 - 2.450	2.320	2.320	------			0.110 - 0.130	0.122	0.125
TOTAL N (MG/L)	3.790 - 3.950	3.870	3.870	------			1.640 - 1.770	1.680	1.655
CHLRPYL A (UG/L)	50.3 - 59.3	54.8	54.8	43.7 - 43.7	43.7	43.7	45.7 - 49.7	47.7	47.7
SECCHI (METERS)	0.2 - 0.2	0.2	0.2	0.4 - 0.4	0.4	0.4	0.3 - 0.3	0.3	0.3

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/19/74	1. Nitzschia sp.	20,657
	2. Stephanodiscus sp.	16,611
	3. Flagellates	9,796
	4. Cryptomonas sp.	3,194
	5. Ankistrodesmus sp.	2,875
	Other genera	5,964
	Total	59,097
07/03/74	1. Aphanizomenon sp.	9,323
	2. Sphaerocystis sp.	6,447
	3. Oocystis sp.	5,612
	4. Crucigenia sp.	1,160
	5. Stephanodiscus sp.	835
	Other genera	1,855
	Total	25,232
09/25/74	1. Merismopedia sp.	28,092
	2. Oscillatoria sp.	3,904
	3. Flagellates	3,140
	4. Aphanizomenon sp.	2,835
	5. Stephanodiscus sp.	2,631
	Other genera	13,665
	Total	54,317

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/19/74	1	50.3
	2	59.3
07/03/74	1	-
	2	43.7
09/25/74	1	45.7
	2	49.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.040	2.380	15.6
0.050 P	0.090	2.380	29.4
0.050 P + 1.0 N	0.090	3.380	32.0
1.0 N	0.040	3.380	15.2

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Black Hawk Lake was high at the time the sample was collected (04/19/74). The addition of only phosphorus produced a significant increase in yield, but no such increase occurred with the addition of only nitrogen. Therefore, phosphorus limitation is indicated.

The lake data substantiate phosphorus limitation during April (the mean inorganic nitrogen/orthophosphorus ratio was 193/1). However, nitrogen limitation is indicated in September (the mean N/P ratio was 6/1).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Iowa National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of April, May, and June when two samples were collected. Sampling was begun in August, 1974, and was completed in July, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Iowa District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station B-1, in kg/km^2/year, and multiplying by the ZZ area in km^2.

No known point sources impacted Black Hawk Lake during the sampling year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Unnamed Stream B-1	1,620	79.6
b. Minor tributaries & immediate drainage (non-point load) -	325	16.0
c. Known municipal STP's - None	-	-
d. Septic tanks* -	25	1.2
e. Known industrial - None	-	-
f. Direct precipitation** -	65	3.2
Total	2,035	100.0

2. Outputs -

Lake outlet - Unnamed Stream A-1 1,635

3. Net annual P accumulation - 400 kg.

* Estimate based on five parks, two camps, and 55 lakeshore dwellings (LeFevre, 1976); see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Unnamed Stream B-1	62,890	78.1
b. Minor tributaries & immediate drainage (non-point load) -	12,680	15.8
c. Known municipal STP's - None	-	-
d. Septic tanks* -	905	1.1
e. Known industrial - None	-	-
f. Direct precipitation** -	4,015	5.0
Total	80,490	100.0

2. Outputs -

Lake outlet - Unnamed Stream A-1 23,995

3. Net annual N accumulation - 56,495 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Unnamed Stream B-1	34	1,335

* Estimate based on five parks, two camps, and 55 lakeshore dwellings (LeFevre, 1976); see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.55	0.11	21.6	15.2

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Black Hawk Lake:

"Dangerous" (eutrophic loading)	0.30
"Permissible" (oligotrophic loading)	0.15

V. LITERATURE REVIEWED

Harrison, Harry M., 1975. Personal communication (lake morphometry). IA Cons. Comm., Des Moines.

Le Fevre, John, 1976. Personal communication (shoreline dwellings at Black Hawk Lake). IA Dept. of Env. Qual., Spencer.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1901	LAKE ACQUADI	0.062	0.335	469.333	8.600	8.200	0.009
1902	BIG CREEK RESERVOIR	0.046	6.465	438.500	16.867	14.800	0.011
1903	BLACK HAWK LAKE	0.185	0.130	488.167	49.740	15.000	0.020
1904	CLEAR LAKE	0.059	0.070	465.125	17.400	8.600	0.010
1905	LAKE DARLING	0.077	1.475	482.500	13.817	9.200	0.012
1906	LOST ISLAND LAKE	0.146	0.065	421.167	36.100	8.400	0.021
1907	LAKE MACBRIDE	0.061	2.035	458.444	17.067	15.000	0.010
1908	PRAIRIE ROSE LAKE	0.056	0.210	463.667	17.350	8.600	0.010
1909	RATHBUN RESERVOIR	0.071	1.170	475.889	12.039	14.000	0.008
1910	RED ROCK LAKE	0.180	1.880	473.400	14.730	14.000	0.104
1911	ROCK CREEK LAKE	0.065	1.400	480.500	18.367	8.400	0.007
1912	SILVER LAKE	0.193	0.565	482.667	95.300	10.000	0.034
1913	SPIRIT LAKE	0.041	0.090	422.667	12.622	9.000	0.007
1914	VIKING LAKE	0.075	0.130	459.000	26.033	14.200	0.017
1915	WEST LAKE OKOBOJI	0.046	0.060	380.444	7.722	15.000	0.017

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1901	LAKE ACQUABI	57 (8)	50 (7)	43 (6)	93 (13)	100 (14)	79 (11)	422
1902	BIG CREEK RESERVOIR	89 (12)	0 (0)	79 (11)	57 (8)	21 (3)	50 (7)	296
1903	BLACK HAWK LAKE	7 (1)	68 (9)	0 (0)	7 (1)	7 (0)	21 (3)	110
1904	CLEAR LAKE	71 (10)	86 (12)	50 (7)	36 (5)	75 (10)	64 (8)	382
1905	LAKE DARLING	29 (4)	21 (3)	14 (2)	71 (10)	57 (8)	43 (6)	235
1906	LOST ISLAND LAKE	21 (3)	93 (13)	93 (13)	14 (2)	89 (12)	14 (2)	324
1907	LAKE MACBRIDE	64 (9)	7 (1)	71 (10)	50 (7)	7 (0)	64 (8)	263
1908	PRAIRIE ROSE LAKE	79 (11)	57 (8)	57 (8)	43 (6)	75 (10)	64 (8)	375
1909	RATHBUN RESERVOIR	43 (6)	36 (5)	29 (4)	86 (12)	39 (5)	86 (12)	319
1910	RED ROCK LAKE	14 (2)	14 (2)	36 (5)	64 (9)	39 (5)	0 (0)	167
1911	ROCK CREEK LAKE	50 (7)	29 (4)	21 (3)	29 (4)	89 (12)	96 (13)	314
1912	SILVER LAKE	0 (0)	43 (6)	7 (1)	0 (0)	50 (7)	7 (1)	107
1913	SPIRIT LAKE	100 (14)	79 (11)	86 (12)	79 (11)	64 (9)	96 (13)	504
1914	VIKING LAKE	36 (5)	68 (9)	64 (9)	21 (3)	29 (4)	32 (4)	250
1915	WEST LAKE OKOBOJI	89 (12)	100 (14)	100 (14)	100 (14)	7 (0)	32 (4)	428

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1913	SPIRIT LAKE	504
2	1915	WEST LAKE OKOBOJI	428
3	1901	LAKE ACQUABI	422
4	1904	CLEAR LAKE	382
5	1908	PRAIRIE ROSE LAKE	375
6	1906	LOST ISLAND LAKE	324
7	1909	RATHBUN RESERVOIR	319
8	1911	ROCK CREEK LAKE	314
9	1902	BIG CREEK RESERVOIR	295
10	1907	LAKE MACBRIDE	263
11	1914	VIKING LAKE	250
12	1905	LAKE DARLING	235
13	1910	RED ROCK LAKE	167
14	1903	BLACK HAWK LAKE	110
15	1912	SILVER LAKE	107

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR IOWA 12/23/75

LAKE CODE 1903 BLACKHAWK

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 60.3

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1903A1	60.3	0.05	0.16	0.57	0.43	0.52	0.45	0.21	0.36	0.19	0.13	0.09	0.07	0.27
1903B1	47.1	0.04	0.12	0.45	0.34	0.41	0.35	0.16	0.28	0.15	0.10	0.07	0.05	0.21
1903Z2	13.2	0.01	0.03	0.13	0.09	0.11	0.10	0.05	0.08	0.04	0.03	0.02	0.02	0.06

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 60.3
SUM OF SUB-DRAINAGE AREAS = 60.3

TOTAL FLOW IN = 3.24
TOTAL FLOW OUT = 3.24

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1903A1	8	74	0.01	17	0.01				
	9	74	0.01	21	0.01				
	10	74	0.01						
	11	74	0.0	2	0.0				
	12	74	0.0	28	0.0				
	1	75	0.0	25	0.0				
	2	75	0.0	22	0.0				
	3	75	0.0	26	0.0				
	4	75	0.62	10	0.48	26	0.34		
	5	75	0.62	12	0.68	27	0.48		
	6	75	0.54	12	0.45	27	0.48		
	7	75	0.24	24	0.20				
1903B1	8	74	0.01	17	0.01				
	9	74	0.01	21	0.01				
	10	74	0.01						
	11	74	0.0	2	0.0				
	12	74	0.0	28	0.0				
	1	75	0.0	25	0.0				
	2	75	0.0	22	0.0				
	3	75	0.0	26	0.0				
	4	75	0.51	10	0.37	26	0.26		
	5	75	0.48	12	0.54	27	0.31		
	6	75	0.48	12	0.48	27	0.42		
	7	75	0.21	24	0.17				
1903Z2	8	74	0.00						
	9	74	0.00						
	10	74	0.00						
	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0						
	4	75	0.14						
	5	75	0.14						
	6	75	0.14						
	7	75	0.04						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

190301
42 18 00.0 095 00 45.0
BLACK HAWK LAKE
19161 IOWA

11EPALES
3

2111202
0005 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/19	13 45	0000	12.7		9	186	8.60	177	0.060	1.400	2.390	0.013
74/07/03	15 00	0000	25.2		14	467	8.90					
74/09/25	09 50	0000	15.2	9.0	12	323	8.22	145	0.070	1.600	0.060	0.022
	09 50	0002	15.2	8.6		323	8.23	145	0.070	1.600	0.050	0.024

22

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/19	13 45	0000	0.161	50.3	
74/09/25	09 50	0000	0.181	45.7	
	09 50	0002	0.197		1.0

STORET RETRIEVAL DATE 75/12/23

190302
42 17 24.0 095 01 48.0
BLACK HAWK LAKE
19161 IOWA

11EPALES
3

2111202
0006 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/19	13 55	0000	12.4		9	187	8.60	168	0.040	1.800	2.150	0.012
74/07/03	14 50	0000	24.5	8.0	15	456	8.90					
74/09/25	10 15	0000	14.6	9.0	12	321	8.14	145	0.060	1.700	0.070	0.019
	10 15	0002	14.6	8.6		321	8.14	148	0.070	1.600	0.040	0.022

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/19	13 55	0000	0.168	59.3	17.0
74/07/03	14 50	0000		43.7	
74/09/25	10 15	0000	0.189	49.7	
	10 15	0002	0.198		1.0

23

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/01/27

1903A1
42 17 30.0 095 00 40.0
UNNAMED STREAM
19015 SAC CO IA HWY MP
0/BLACKHAWK LAKE
BRDG ON RD 2 MI ESE OF LAKE VIEW
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/17	15 20		0.136	1.900	0.120	0.015	0.155
74/09/2.	13 30		0.020	2.100	0.020	0.020	0.180
75/04/10	16 10		0.750	2.700	0.045	0.035	0.260
75/04/26	19 00		0.010	2.800	0.030	0.040	0.200
75/05/12	20 00		0.125	4.000	0.045	0.020	0.180
75/05/27	19 35		0.095	1.680	0.220	0.020	0.090
75/06/12	20 01		0.540	3.700	0.875	0.065	0.200
75/06/27	19 50		0.390	2.100	0.540	0.095	0.140
75/07/24	16 50		0.010	1.350	0.030	0.290	0.380

STORET RETRIEVAL DATE 76/01/27

190381
42 17 00.0 095 03 00.0
UNNAMED STREAM
19 SAC CO IA HWY MP
T/BLACKHAWK LAKE
BRDG ON RD 1 MI S OF LAKE VIEW
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/17	15	50	1.200	1.600	0.270	0.280	0.470
74/09/21	14	00	0.020	2.800	0.060	0.090	0.420
74/10/20	10	18	0.024	1.600	0.185	0.040	0.260
74/11/03	14	00	0.016	2.000	0.150	0.045	0.230
75/04/10	15	53	9.600	1.500	0.165	0.150	0.290
75/04/26	19	10	8.700	1.180	0.165	0.180	0.260
75/05/12	20	10	10.000	1.250	0.025	0.005	0.120
75/05/27	19	45	10.500	0.900	0.070	0.065	0.130
75/06/12	20	10	10.500	1.700	0.100	0.095	0.220
75/06/27	20	17	9.700	1.200	0.105	0.090	0.190
75/07/24	17	00	1.150	2.400	0.230	0.190	0.500